MSIAC JOURNAL

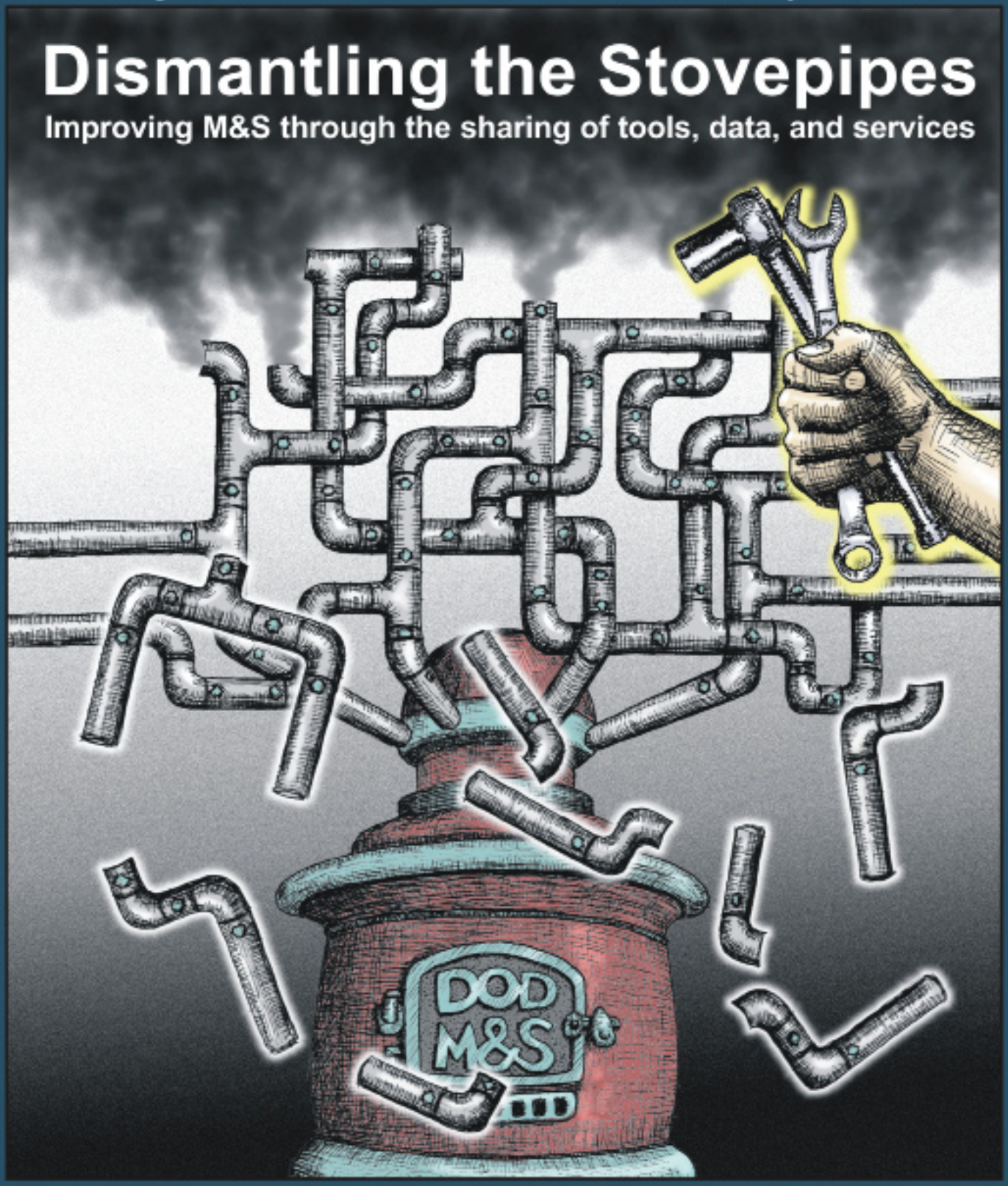
May 2007

Special DMSC Issue

Modeling & Simulation Information Analysis Center

Dismantling the Stovepipes

Improving M&S through the sharing of tools, data, and services



Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
MAY 2007		**00-00-2007 to 00-00-2007**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
MSIAC Journal, Special DMSC Issue, May 2007	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Modeling and Simulation Information Analysis Center (MSIAC),1901 N. Beauregard Street Suite 500,Alexandria,VA,22311**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited
13. SUPPLEMENTARY NOTES
14. ABSTRACT
15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**13**	

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From the Director

Welcome to a special themed edition of the MSIAC Journal that underscores the DoD Modeling and Simulation Conference theme of "taking the power of Modeling and Simulation to the Warfighter" through a selection of papers and articles addressing greater coordination, promoting information sharing, and highlighting key organizational concepts. The MSIAC Journal is published quarterly as a print and electronic compendium of technical papers from experts in the M&S field and serves as a forum for new ideas and emerging philosophies from the communities most enabled by Modeling and Simulation.

The topic of this print edition is "Dismantling the Stovepipes." Here, we present some of the advantages of sharing tools, data, and services to enhance total force capabilities across DoD, other governmental agencies, academia, and industry through the exchange and promotion of M&S practices, new approaches to management within DoD M&S, and the creation and employment of more effective and efficient M&S capabilities.

What do we mean by "stovepipes," and what are the advantages of "dismantling the stovepipes?" The term stovepipes connotes single-purpose projects or designs that are little used and known outside the community they were developed in. Dismantling stovepipe systems clearly benefits M&S users in many ways. The first is through cost reduction, i.e, improving efficiencies by sharing M&S tools, data, and services across many programs and communities. Schedule could be shortened since re-use can lessen development time and improve efficiency. Risk could also be reduced because tools, data, and services have already been proven effective ("verified and validated") by tens, hundreds, and even thousands of other users.

One big question with sharing tools, data, and services is if their performance will meet your needs. Without going into great detail, the answer begins (as always) with requirements. If sharing a tool, data, or service doesn't quite meet your needs either in features, capability, or speed of execution, then you must trade off existing performance shortfall vs. cost, risk, and schedule. Otherwise, you can decide to modify/adapt the capability. However, there can be significant cost and schedule issues involved in these modifications, and risk, too, since the modified system has no longer been tested by other users.

If you're intrigued, here is one way to find those tools, data, or services: the MSIAC is working hard to discover, evaluate, and catalog these technologies, and you can contact us at http://www.dod-msiac.org/.

I hope you enjoy this special edition of the MSIAC Journal, and I anticipate future issues providing additional cutting edge "food for thought".

Dane Mullenix, MSIAC Director

A Unique Approach for Managing DoD Modeling and Simulation (M&S)

Modeling and Simulation Coordination Office (M&S CO)

The recent re-designation of the Defense Modeling and Simulation Office (DMSO) as the Modeling and Simulation Coordination Office (M&S CO) on Oct. 27 was a visible sea change in the Department's on-going revision of the way DoD manages M&S.

In recent years, it became evident to DoD senior leaders that the original approach for managing M&S at the Department level via the Defense Modeling and Simulation Office (DMSO) and the Executive Council on M&S (EXCIMS) fell short in implementing the original Departmental M&S vision, policies, and plans established in the early 1990's. They asked where would we be today if the Department had fully implemented the original 1994 policy for managing M&S (DoD Directive 5000.59) and 1995 M&S Master Plan (DoD 5000.59-P). The senior leaders thought that given 13 years, the better part of a billion dollars counting just the DMSO budget from 1994 to 2007, and many more billions of dollars throughout the Department, we should be much further along on that vision than we are.

So, starting in 2004 internally to DMSO, and culminating in the fall of 2005 with an FY07 Program Review Issue Team and Program Decision Memorandum, the senior leadership directed a revision of the Department's approach to managing M&S.

Initiatives over the past 18 months include a new DoD Directive 5000.59, currently in formal coordination; replacing the three/four-star level EXCIMS with a one/two star level M&S Steering Committee (M&S SC) supported by an M&S Integrated Process Team (M&S IPT); and a repurposed DMSO, simultaneously re-designated as the M&S Coordination Office (M&S CO). The M&S SC's goals are to enable improvements in the efficiencies, effectiveness, visibility, accessibility, commonality, reuse, and interoperability of M&S affecting the billions of dollars spent annually by DoD on M&S. The premise of the M&S SC approach is that these goals are only achievable via collaboration among, and implementation by, the DoD Communities and Services.

Figure 1 (on the next page) depicts the new M&S SC based management structure. The M&S SC is organized based on, and designed to support, major DoD Communities that are highly enabled by M&S. The M&S SC currently recognizes six such Communities: Acquisition, Analysis, Experimentation, Planning, Testing, and Training. The Military Services are recognized as the "industrial base" for most DoD M&S and participate at two levels, as members on the M&S SC and as members of the above Communities. The M&S SC has charged each of the Communities with developing a business plan that describes what M&S capabilities they have, what capabilities they need, what they can make available to the other Communities, what they need from the other Communities, and what actions they plan to has tasked the M&S IPT and M&S CO to support the Communities in creating their business plans and to lead the creation of a Common & Cross-Cutting M&S Business Plan that uses the Community business plans both as foundations and input.

The M&S SC, M&S IPT, and M&S CO are just starting the FY08 business planning cycle; which will culminate in August with the FY08 versions of the Community business plans, an FY08 plan for those challenges addressable using M&S CO funding, and the identification of a set of challenges that cannot be addressed using M&S CO funding. The M&S SC will address these latter challenges by either creating M&S SC collaborative efforts or queuing them up for DoD senior leader review.

A New Approach for Managing DoD Modeling and Simulation (M&S)

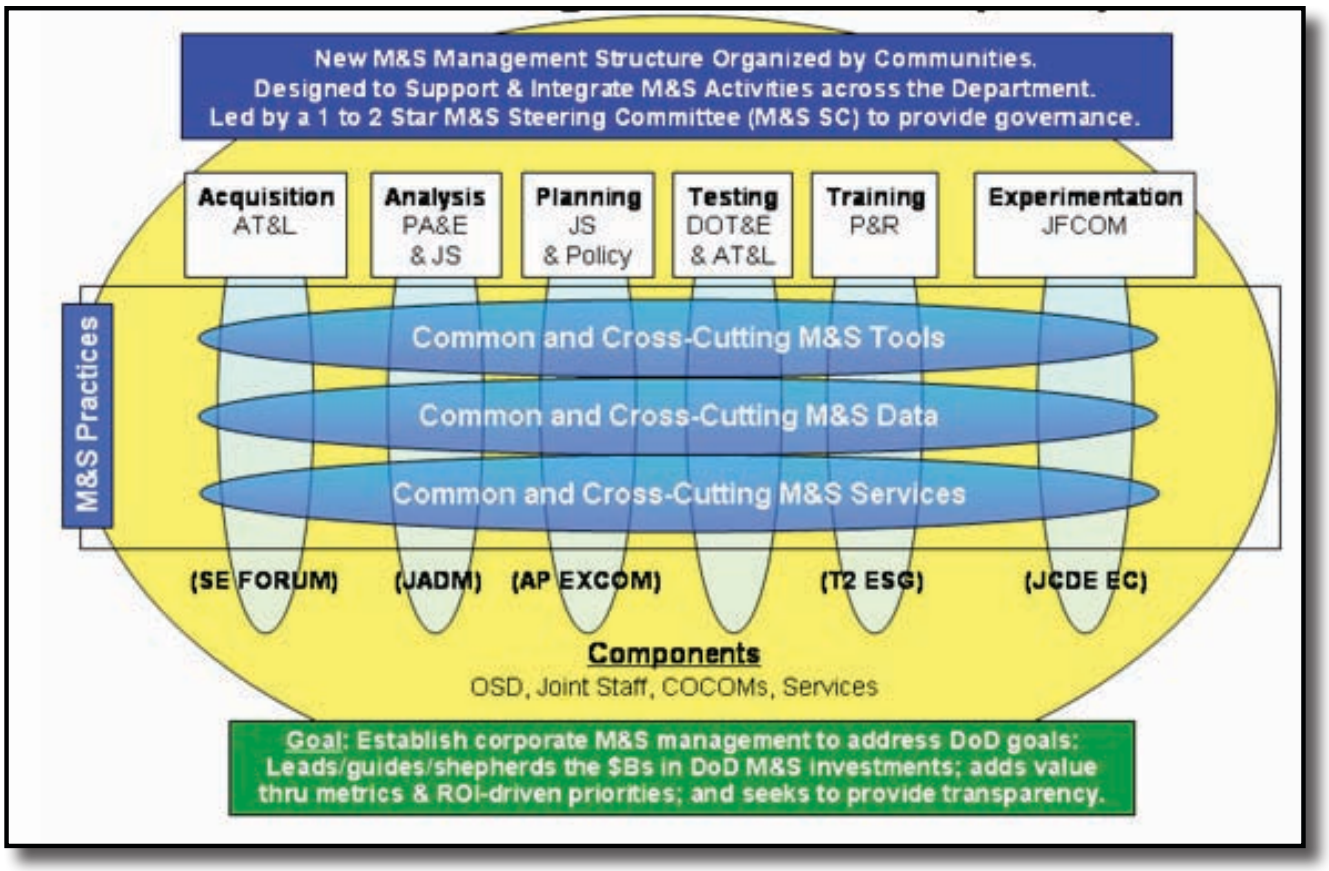


Figure 1: The new M&S SC based management structure.

The Environmental Scenario Generator (ESG) System - A Continuing Success Story

ESG Program at https://esg.afccc.af.mil

ESG, an automated toolkit that generates realistic atmospheric representations for use in DoD applications, is now easier to use, more cost effective, and produce faster results. The ESG provides the means for simulation users to specify a geographic area and environmental conditions of interest and find historical air, space, and ocean scenarios that satisfy the specified simulation event conditions.

Because of the importance of M&S realistic representation of the natural environment, DMSO and the Air & Space Natural Environment, M&S Executive Agent (MSEA) joined forces in 1998 to begin development of an ESG capability to produce high quality on-demand environmental representations.

In the past, it was too hard, took too long, and was too expensive for simulation programs to develop realistic environmental representations. Each simulation program had to start from scratch, often spending hundreds of thousands of dollars and waiting up to a year just to get a few weeks worth of environmental data. Even then the data sets provided were not easily used or physically consistent.

With ESG, simulation programs now have a single point of contact for obtaining realistic atmospheric representations. The ESG makes it easy to obtain the required representations by allowing simulation users to specify the required parameters to meet conditions of interest (e.g., "cold and snowy" or "hot and dusty"), the area and time/season of interest, and the desired delivery format. ESG is responsive – an 18 month regional dataset for a current ESG user, the Joint Warfare System (JWARS), took four months to produce in 1999, but now takes only one month. In addition, the ESG eliminates the often-high cost of data production by generating atmospheric environmental data sets at no cost to DoD users.

In a recent analytical exercise, the JWARS simulation produced "unexpected" results in Intelligence, Surveillance, and Reconnaissance sensor behavior. While executing a scenario supporting the DoD Analytical Agenda, JWARS analysts selected a time period with a strong storm present for their area of interest. JWARS is designed to observe and address realistic system behaviors. However, having previously used interactions, the analysts were able to observe and address realistic system behaviors. However, having previously used legacy simulations with few if any environmental interactions, the analysts had never before been faced with comprehensive environmental effects. The JWARS Program Office said this case demonstrated JWARS' unique capability to account for a dynamic natural environment.

This revolutionary system will produce a responsive and authoritative Just-In-Time environmental representation production capability, and simulations like JWARS will be able to obtain all their environmental data from a single source, the ESG.

Current ESG capability is primarily atmosphere-oriented. The ASNE MSEA is transitioning this DMSO-funded technology to an operational prototype system at the Air Force Combat Climatology Center (AFCCC) in Asheville, NC. AFCCC generates the atmospheric data requested by M&S users through the ESG with the user-specified conditions meeting the criteria needed for the simulation.

There is a comprehensive slide presentation available on the ESG program at

https://esg.afccc.af.mil

Click on "View Graphic Version".

Capabilities-Based Costing: Approaches to Pre-Milestone - A Cost Estimate

Office of the Deputy Assistant Secretary of the Army for Cost and Economics (ODASA-CE), Martha Roper, Senior Analyst

The issue of early, rigorous evaluation of program costs is becoming more important as defense funding comes under greater scrutiny. Often at this point in the life cycle, a requirement or desired capability is known, but the manifestation of the solution is unknown or described only at a high level. Can capabilities alone be used to produce a cost estimate? If so, how can we link the proposed solution to existing systems if only a particular solution's general capability set is known?

This work submits that better strategic decisions within fiscal constraints could be made if rough order of magnitude (ROM) estimates were available for proposed materiel or non-materiel solutions, based on that solution's capability set. This project further proposes the use of a knowledge base to provide support for these estimates; it is known as the joint Capabilities Knowledge Base (CKB). By using the relevant entities extracted from CKB, a ROM cost estimate may be developed using a wide spectrum of techniques.

According to Department of Defense (DoD) guidance dated June 19, 2006, the [2006] Quadrenniel Defense Review (QDR) report called upon senior departmental leaders to "better integrate the processes that define needed capabilities, identify solutions and allocate resources to acquire them in order to enable corporate decision-making that cuts across traditional stovepipes". In response to this directive, DoD leaders are evaluating a new early lifecycle decision-making framework that includes a Concept Decision (CD) Review (supported by an Evaluation of Alternatives or EoA). The CD Process has been set forth as a way to combine requirements, capabilities portfolio evaluation, and resource allocation considerations in the pursuit of joint, efficient, and well-informed decision-making early in the acquisition life cycle. The Concept Decision will either replace or occur in conjunction with Milestone A to decide which of the prospective solutions provided by the EoA will best enhance overall US defense capability while balancing priorities of cost, schedule, and risk management.

The issue of early and rigorous evaluation of program costs becomes more and more important as defense funding becomes more scrutinized. Clearly, decision-makers need high-fidelity cost information at this key decision point, but more often than not, it is scant. Providing reliable, useful cost estimates very early in the acquisition life cycle is challenging for several reasons. Often at this point in the life cycle, a requirement or desired capability is known, but the manifestation of the solution is unknown or described only at a high level. This is certainly a challenge, given that defense cost estimating is usually performed given a detailed system description. Given the changing face of the battlefield and warfare, proposed solutions are often unlike anything presently in existence.

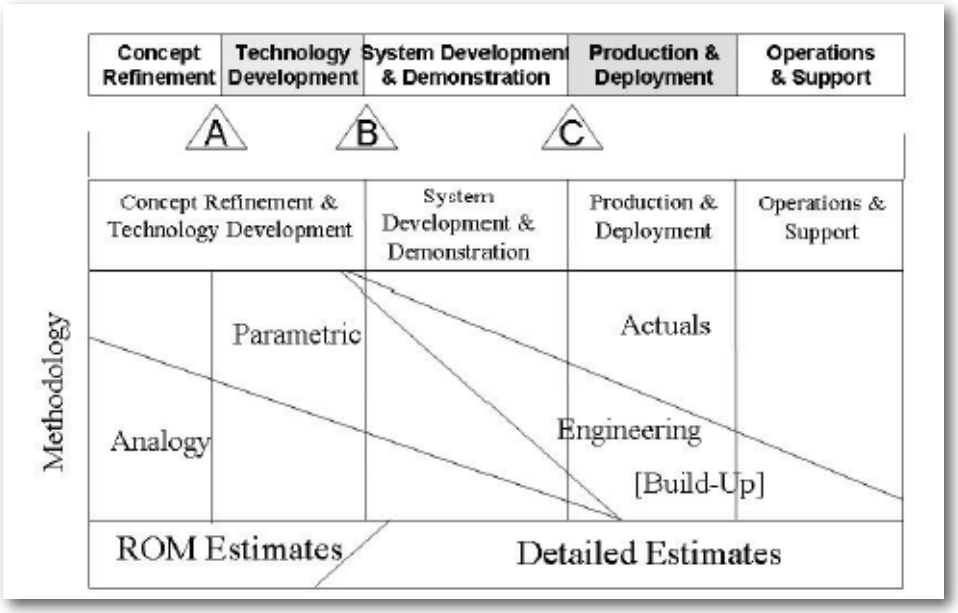


Figure 1: The Cost Estimating Spectrum

As any cost estimator can confirm, there exists a spectrum of situations in which a cost estimate may be prepared. One theoretic extreme is creating a cost estimate in a situation where there is very little information about the item being estimated and no supporting data. The other extreme is when the entity being estimated is fully understood, and all data exists to estimate the cost exactly. In this case, the data are actual costs after the item has been developed, constructed, or bought. Figure 1 shows these extrema along with all points in between.

As we progress from the point of no information to the point of perfect information, our cost estimating methodology changes to suit the information climate. For instance, when information about the item or service is higher-level and/or data is not readily available (Figure 1, cost estimators tend to rely upon analogies and parametric methods to produce their estimate. However, as we move toward the right, estimates tend to utilize more "data-hungry" methodologies such as engineering builds and projections using actual costs to date. It is also clear to the casual observer that as we move along the spectrum from left to right, we may expect our estimate to be more reliable and closer to the actual cost at project or acquisition completion.

The pre-Milestone-A costing environment is particularly challenging. This is the stage in which information is often extremely scarce. Figure 2 illustrates the "sub-spectrum" of pre-Milestone-A data availability.

Depending upon the situation, there may be one or many proposed solutions to a set of capability gaps before Milestone A. These solutions could be a materiel system such as a vehicle or software package, or it could be a non-materiel solution, such as a policy change or a training curriculum change. As one can see in Figure 2, the information regarding the proposed solution(s) could range from simply the desired capability expressed in very qualitative terms to a relatively detailed, well-developed concept with some technical platform specifications. The most commonly-occurring scenario, however, is nearer to the middle where there exists high-level capabilities information along with some very general solution information.

Since every cost estimate of an item or project must be based on some type of past experience, pre-Milestone-A cost estimating is no exception. How can we link the proposed solution to existing systems (our past experience) if we know only a particular solution's general capability set? Can capabilities alone be used to produce a cost estimate? If so, could that cost estimate be used in decision-making with any degree of confidence?

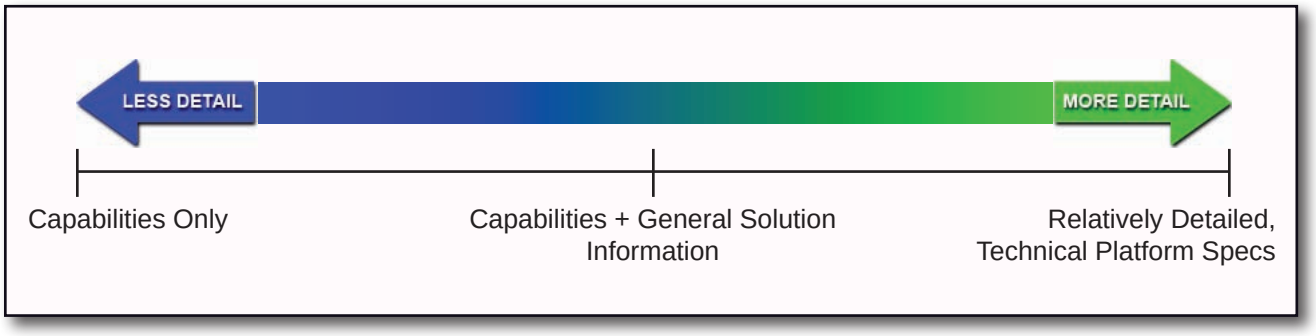


Figure 2: Spectrum of Information Availability at Milestone A

Suppose we made the assumption that a system's capabilities have a relationship to its cost. To the casual observer, this assumption seems rather logical. If we buy something that can do more, do it quicker, or do it better, then it should cost more. However, one can identify situations in which this assumption might not hold; if a particular computer technology is maturing at an accelerated rate, the cost to acquire that capability might not be correlated to the cost of acquiring a similar capability five years ago. Yet, even this example has a relationship between capability and cost upon closer inspection; to arrive at an acceptable cost estimate one

must understand the rate of technology maturation (and this maturity information may or may not be available to the analyst). The question at hand, however, is whether or not capabilities can predict cost within some acceptable level of percentage error to provide decision makers with data that helps avoid decisions that would yield negative future cost effects. In theory, these decisions could be avoided if a rough order of magnitude (ROM) estimate is available that is based on the proposed materiel solution's set of capabilities.

The capabilities costing team at the Office of the Deputy Assistant Secretary of the Army for Cost and Economics (ODASA-CE) is currently tackling the challenging pre-Milestone-A costing environment. Our approach includes the use of a knowledge base that records current system cost information and capabilities. In fact, the Joint Capabilities Knowledge Base (CKB) is presently under construction. By using the relevant entities extracted from the CKB, a ROM cost estimate may be developed using a wide spectrum of techniques.

Numerous costing approaches are being examined and developed as this project evolves, one of which follows: Let us assume that the set of capabilities requiring a cost estimate is rank-ordered; in other words, we know which capabilities among the group are most critical, somewhat necessary, or only slightly needed. Depending on whether the entities (that will be extracted from the CKB) have exact or partial matches in capabilities, we can then apply an appropriate weighting factor for certain combinations of capability matches; exact matches would receive a higher weighting than partial matches, for example. Next, relevant entities are extracted from the knowledge base that can be used in our cost estimate. The assigned weightings are applied. If a particular system entity is deemed to be even more relevant to the solution being estimated, it may be further emphasized in a variety of ways.

Larger-scale case studies using realistic scenarios are under development to test the usefulness and strength of the methodology frameworks being considered, which include simplistic techniques like that described above to more intricate parametric and data mining approaches. It is important, however, to emphasize that cost estimates at this point in the life cycle are highly situation-specific, and thus methodologies under development are only recommended strategies. The analyst's judgment is a key component.

Martha Roper is an Operations Research Analyst (ORA) with the Office of the Deputy Assistant Secretary of the Army for Cost and Economics (ODASA-CE). Ms. Roper is leading early-life cycle cost analysis initiatives in conjunction with analysts Nancy Houdek and Katherine McCormack.

BOMworks™ Community Edition

Background

It has been long recognized that "to allow maximum utility and flexibility, modeling and simulation environments [should] be constructed from affordable, reusable components interoperating through an open systems architecture." The key in achieving this goal is to ensure models representing these reusable components are based on a common format – a common standard – thereby allowing composability to take root. To this means, the Modeling and Simulation Coordination Office (M&S CO), and other organizations have supported the development of a composability standard known as Base Object Models (BOMs). Having achieved standardization as a Simulation Interoperability Standards Organization (SISO) product in early 2006, which is identified as SISO-STD-003-2006, the BOM has emerged to provide a component framework for supporting conceptual modeling and facilitating interoperability, reuse, and composability. To complement this composability standard, the need for BOM-focused tools, which encourage conceptual modeling and component-based simulation development, has also been recognized.

Developed originally by SimVentions as an aid to help validate and test the BOM specification as it was being developed within SISO, BOMworks™ quickly became a tool to teach others about the BOM concept. BOMworks™ has now evolved into to an intuitive tool environment that helps encourage conceptual modeling, object modeling and mapping, thereby supporting the technology adoption of the BOM standard within the community. Written in Java, BOMworks™ can be run on a myriad of platforms including Windows, Mac OS X, and Linux. Best of all, the BOMworks™ Community Edition executable is available as a free download to the general community.

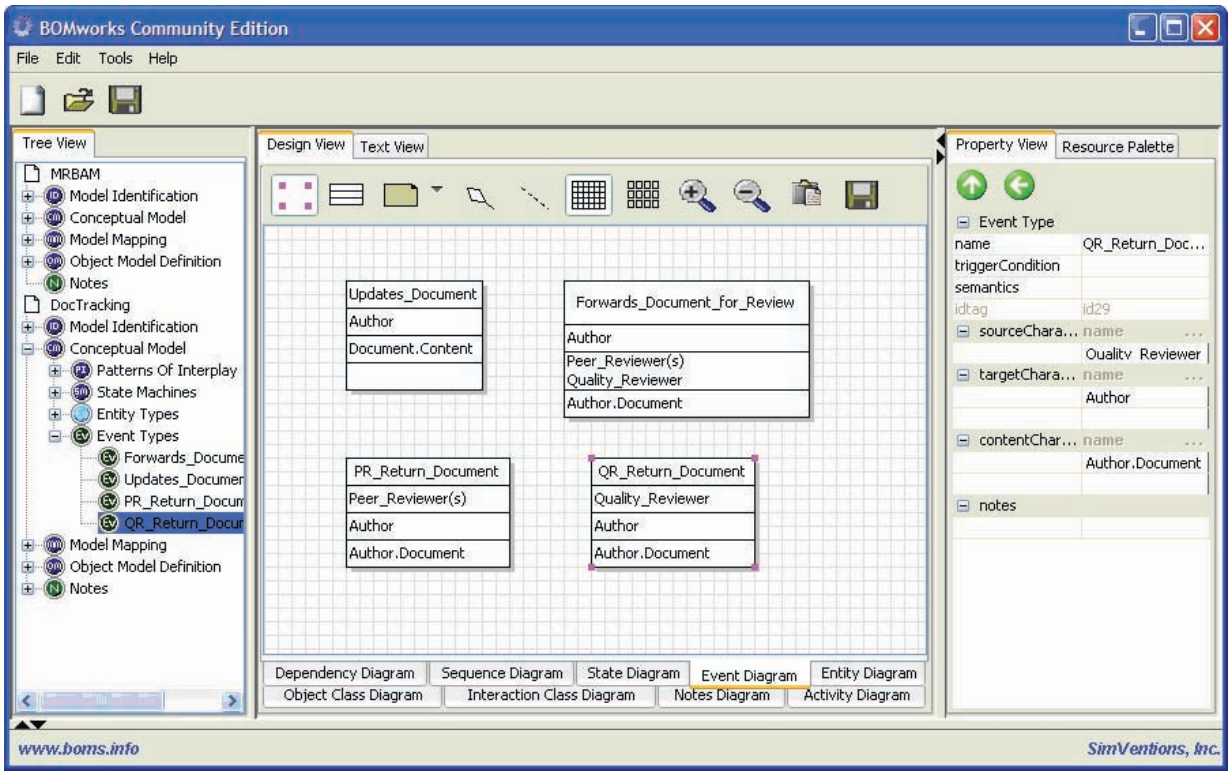
BOMworks Tool™ Overview

BOMworks™ is a tool for developing and working with BOMs. BOMworks™ provides the user with all of the necessary components and tools required to not only develop BOMs and aggregations of BOMs but also to build a better understanding of the system being represented through the use of BOMs.

The BOMworks™ Navigation Panel (displayed on the next page), which is featured on the left hand side of the application, presents a mechanism to explore information quickly and easily. BOMs and FOMs are presented hierarchically using a tree view, and their elements can be added, deleted, expanded, collapsed, copied, cut and pasted in a straight forward manner.

The main client area of BOMworks™, featured in the center of the application, provides a series of editors, which are accessed through various tab sheets. Each tab offers different editing functionality within the application including a Text View editor and a Design View editor. The Text View provides a fully functional XML editor built into BOMworks™, including full color marking of the XML syntax. Through this editor, it is possible to change any and all aspects of a BOM that is open. Such changes made within the Text Editor are immediately reflected in other views including the Navigation Panel, and the Property View. The Design View editor, on the other hand, offers a fully functional, drag-and-drop visual designer. Visual components for the Design Editor include, Sequence Diagrams, Activity Diagrams, State Diagrams, Class Diagrams for Entities, Events, Object Classes, and Interaction Classes, Notes Diagram and a Dependency Diagram. More editor components are planned.

As another means for editing, a Property View window is also provided. This Property View in addition with a Resource Palette are found on the right hand side of the application. The Property View provides access to all of



BOMworks™ Navigation Panel

the details within the BOM or FOM being examined. Fields are all broken out into logical groupings so that finding and modifying data is easy, straightforward and organized. The Resource Palette, on the other hand, provides quick access to BOMs and FOMs that have been previously constructed or downloaded. Each BOM or FOM in the Resource Palette can be opened with a right-click, and used to help create BOM Assemblies.

Summary

The BOMworks™ Community Edition provides M&S engineers the ability to leverage the world of reuse and composability that BOMs offer. Specifically it is a tool to help design, develop, modify, and manage M&S components (i.e., BOMs), build FOMs from BOMs, or convert existing FOMs to BOMs. BOMworks™ provides the user with the ability to perform the following:

- Creating BOMs from scratch
- Creating a BOM from other BOMs either via copying or by aggregating two or more BOMs
- Decomposing an existing FOM into FOM pieces and dragging these pieces into a BOM
- Editing BOMs graphically via one of several Design Views or directly via XML with the Text View editor
- Exporting BOMs to High Level Architecture (HLA) 1.3 and 1516 FOMs
- Generating Hyper Text Markup Language (HTML) documents from a BOM
- Reflecting Unified Modeling Language (UML) class, activity, and sequence diagrams from BOMs
- Exporting diagram images as JPGs
- Validating and verifying BOMs
- Generating source code "stubs" for classes described in BOMs

BOMworks™ is intended to support the rapid development of BOMs and provides a means to enables application of BOMs both in the modeling and simulation domain, capable of supporting various interoperability architectures such as HLA, DIS and TENA, and the software development community, encouraging the development of conceptual models, and supporting software components. In summary, BOMworks™ provides a solid environment for BOM development and offers a platform that can be further extended to support your specific needs.

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